In re Patent Application of:
**FARRIES**
Serial No. **09/886,998**
Filed: **06/25/2001**



**REMARKS**

Claims 1-17 are pending in this application.

Claims 1-17 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement.

Claims 1, 15 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mollenauer (US Patent No. 5,710,649) in view of Chraplyvy et al (US Patent No. 6,205,268).

Claims 2-14 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mollenauer (US Patent No. 5,710,649) in view of Chraplyvy et al (US Patent No. 6,205,268) and further in view of Lin et al (US Patent No. 6,782,203).

Claims 1, 15 and 16 have been amended.

Introduction

An object of instant invention is to provide a low loss, low error rate, high bit-rate demultiplexer capable of demultiplexing optical signals, particularly in the presence of overlap of adjacent wavelength channels.

In a wavelength division multiplex (WDM) optical communication system, a problem of optical crosstalk between adjacent channels can arise when the optical bandwidth of such channels widens as the transmission rate is increased.

To practically address this problem, optical filters of high figure-of-merit and separating qualities are required. For a system of many channels this increases the cost, vulnerability to drift and can reduce reliability of transmission.

Further, the achievable figure-of-merit of optical filters tends to decrease as the width of the filter pass band is increased. According to this invention, it is advantageous to reduce the optical signal bandwidth by time-division demultiplex before performing the final filtering of a channel, thereby reducing the number of high quality filters required.

This use of OPTICAL TIME DOMAIN DEMULTIPLEX for reduction of channel bandwidth is novel, in particular when applied in three stages:

a) optical wavelength domain demultiplex

+

b) optical time domain demultiplex

+

c) optical wavelength domain demultiplex.

In contrast, known prior art systems consist of only two stages: optical wavelength domain demultiplex + optical time domain demultiplex or optical wavelength domain demultiplex + electronic time domain demultiplex.

Claims 1, 13 and 15

The Office Action dated 2nd June 2006 alleges that Claims 1-17 fail to comply with the written description requirement, so are rejected under 35 U.S.C. 112, first paragraph.

Specifically, in Claims 1 and 15 the phrases

> "wavelength demultiplexing means for receiving the optical signal and for dividing the optical signal into a plurality of demultiplexed wavelength bands"

and

> "at least one of the demultiplexed wavelength bands has more than one wavelength channel for carrying data information"

are said to have not been described in the specification.

Applicant accepts that the used word "bands" has many other broader meanings than that encompassed in instant application. This word has been changed to "streams", in line with the description in the specification, for instance in the "Summary of Invention", paragraph [08]. The corresponding amendments appear in Claims 1, 15 and 16.

Additionally, the phrase "data information" contains a redundancy, as "data" implicitly comprises information. For improved clarity, the word "information" has been deleted from the Claims 1 and 15. "Wavelength channels transmitting data" has been described in, for instance, "Background of Invention", paragraph [03].

By making the above amendments, the Applicant believes that Claims 1 and 15 now accurately reflect the subject matter described in the specification and thus comply with the written description requirement under 35 U.S.C. 112, first paragraph.

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In relation to Claim 13, the rejection is based on an allegation that the following phrase was not described in the specification:

> "first wavelength demultiplexing means for coarse wavelength demultiplexing the plurality of multiplexed N channel optical sub-signals into M sub-signals wherein at least one of the M sub-signals comprises more than one wavelength channel".

Comparing this to the description in "Summary of Invention", paragraph [11] (underlined part), it should be clear that the first part of the phrase objected to in Claim 13 appears verbatim with the exception of the additional word "wavelength":

> "The invention further provides an optical demultiplexer for demultiplexing a multiplexed N channel optical signal comprising splitting means for splitting the multiplexed N channel optical signal into a plurality of multiplexed N channel optical sub-signals, first demultiplexing means for coarse wavelength demultiplexing the plurality of multiplexed N channel optical sub-signals into M sub-signals, second demultiplexing means for time demultiplexing the M sub-signals into R sub-signals, and third demultiplexing means for wavelength demultiplexing the R sub-signals into N single channels."

The word "wavelength" has been purposely inserted between "first" and "demultiplexing means" to distinguish from the time division demultiplexer. It is already implicit in the phrase "for coarse wavelength demultiplexing", therefore

repeating it cannot be deemed to constitute a substantial addition.

The second half of the phrase objected to in Claim 13, "wherein at least one of the M sub-signals comprises more than one wavelength channel" embodies one of the main objects of instant invention and is described in several places within the specification. In the following, it must be noted that the M sub-signals constitute the input to the optical time domain demultiplexer.

For instance, consider the "Detailed Description of Preferred Embodiments", paragraph [26], page 6, line 26 quoted here:

> "The signal output from the time domain demultiplexer still contains light at the channel wavelength and the adjacent channels".

Another example appears in Figure 1, where numeral 18 points to three wavelengths in the wavelength domain at the input of the optical time domain demultiplexer, while 22 points to three wavelengths at the output of same.

In both examples, this plurality of wavelength channels corresponds to the content of at least one of the M sub-signals. Thus, to someone skilled in the art, the phrase in Claim 13, "wherein at least one of the M sub-signals comprises more than one wavelength channel" would be a clear definition of what has been described in the specification.

The Applicant believes to have clearly demonstrated that Claim 13 is fully based on subject matter described in the specification and thus complies with the written description requirement under 35 U.S.C. 112, first paragraph.

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Claims 1, 15 and 16

In the Office Action it is alleged that Mollenauer discloses the system claimed in instant application. However, there are several substantial differences, as will be described below.

Firstly, it is stated that the wavelength division multiplexer 26 in Fig. 1 of Mollenauer corresponds with the wavelength demultiplexing means in Claims 1 and 15 of instant application. This is not correct, because a major difference has been overlooked.

In Claim 1, output from the wavelength demultiplexing means specifically has at least one stream containing several wavelength channels:

> "wherein at least one of the demultiplexed wavelength streams has more than one wavelength channel".

Mollenauer, to the contrary, teaches a conventional wavelength division multiplexer, which separates the input into separate single wavelength channels, as described in column 7, lines 48-51:

> "After transmission through the medium 24, the pulses are wavelength division demultiplexed by the demultiplexer 26, which separates the transmitted signal into separate wavelength channels".

This is reiterated in column 7, lines 58-59, noting that the word "wavelength" appears in singular:

> "Each demultiplexed wavelength channel is coupled to time division demultiplexers 28a-28d, respectively".

In other words, each time division demultiplexer receives only a single wavelength. Claims 1 and 15 definitively claim otherwise.

Secondly, in the Office Action it is alleged that in the system disclosed by Mollenauer, the receivers (Fig. 1, 30a-30p) perform a further wavelength division demultiplex function:

> "optical filtering means (i.e., receivers **30a-30p**, Fig. 1) for wavelength demultiplexing the time domain demultiplexed signals into separate wavelength channels (col. 5, lines 45-67, col. 6, lines 1-22, col. 9, lines 47-67 and col. 10, lines 1-40)".

Careful reading of cited lines in Mollenauer's patent reveals no basis for the above assertion. In particular, in his own words, "Fig. 5 is a schematic of the time division demultiplexer **28**" (col. 9, lines 47-48), which is not the same as a wavelength division demultiplexer.

It would be erroneous to interpret the electronic filters as performing any demultiplex function. For instance, Fig. 5 in the above patent displays two filters, a low-Q resonator 52 and a hi-Q resonator 54, receiving signal from the splitter 50. It is important to observe, however, that the optical signal 46 is converted to an electric signal within the detector 48 which feeds the splitter through amplifier 56. The electric signal does not contain any optical wavelength information, nor can the circuit in Fig. 5 perform a wavelength division demultiplex function, as would be clear to someone skilled in the art.

Furthermore, Mollenauer does not indicate any motivation for wavelength division demultiplexing the signal following the time division demultiplexer. This should be perfectly understandable to someone skilled in the art, since the signal entering the time division demultiplexer contains only one wavelength.

Thus, instant application cannot be deemed obvious in light of the disclosure of Mollenauer for the two substantial differences just described.

Considering the above, the question on whether the first wavelength division demultiplexer is coarse or not becomes moot, rendering any reference to Chraplyvy unnecessary.

For similar considerations, the details of Mollenauer's teaching on identifying timing signal techniques in a time division demultiplex system are not relevant to Claim 16. Although the Office Action mentions "wavelength streams", this quotation is taken from instant application's Claim 16 and not from Mollenauer's patent. As was demonstrated previously, Mollenauer's time division demultiplexer operates on a single wavelength signal, so generalizing it to a "stream" and thereby implying several wavelengths has no basis within his description (for instance, column 7, lines 48-51 and 58-59).

The Applicant therefore respectfully submits that Claims 1, 15 and 16 cannot be deemed as unpatentable over Mollenauer in view of Chraplyvy et al. under 35 U.S.C. 103(a).

Claims 2-14 and 17

For Claims 2-14 and 17, the same arguments as presented above for Claims 1 and 15 apply also. Furthermore, Lin teaches

various strategies for optical wavelength demultiplexers. In all embodiments he describes, every output contains only a single wavelength.

His type of optical wavelength demultiplexer does not apply to instant application, as the first demultiplexer claimed in instant application explicitly does not have the single wavelength output restriction imposed. This is defined in Claims 1 and 15 by the words:

> "wherein at least one of the demultiplexed wavelength streams has more than one wavelength channel for carrying data".

In fact Lin makes a big point about cleaning up each channel spectrally as evidenced by the attention devoted to cross-talk between channels, for instance in Fig. 5, which is in direct contrast to the object of Claims 1 and 15 in instant application.

Also, Claim 1(b) of instant application defines the use of optical time domain demultiplexing as a means to reduce the optical bandwidth of the channels. As an example, a 40 Gb/s optical signal stream can be demultiplexed by time domain techniques to 4 streams of 10Gb/s each, with attendant reduction in optical bandwidth. Thus, a narrower pass-band post filter can be used to separate the $\lambda_2$ channel from its neighboring channels $\lambda_1$ and $\lambda_3$. If one were to compare instant application with the apparatus disclosed by *Lin et al.*, the time domain demultiplexing would be interposed between demux 310 and post-filter 320 in Fig. 7 of Lin et al.

Such optical bandwidth reduction comprises one of the objects of instant disclosure (for instance, Claim 1(b)), for which

Lin's patent has no corresponding counterpart. Clearly such bandwidth and cross-talk approaches have not been recognized by Lin et al., nor have they suggested, explicitly or implicitly, a remedy for this problem along these lines. Thus it is not at all obvious how instant disclosure can be derived from the teachings of Lin et al. It is therefore submitted that in the absence of a motive or an appropriate example from the patent of Lin et al., it would not have been obvious to a person having ordinary skill in the art at the time of the invention to incorporate an optical time division demultiplexer apparatus as claimed in instant application.

The Applicant therefore respectfully submits that Claims 2-14 and 17 cannot be deemed as unpatentable under 35 U.S.C. 103(a) over Mollenauer in view of Chraplyvy et al. and further view of Lin et al.

Finally, in view of the foregoing amendments and remarks, it is respectfully submitted that all Claims as amended are patentable in view of cited references.

Early and favorable reconsideration of the Examiner's objections would be appreciated.

Should any minor informalities need to be addressed, the Examiner is encouraged to contact the undersigned attorney at the telephone number listed below.

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Respectfully submitted,
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